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## Hydro Damper

The invention relates to a hydro damper for attenuation of pressure oscillations and/or acoustic oscillations in systems which can use pressurized fluids for their operation.

In hydraulic systems, equipment-induced processes of varied types can lead to pressure fluctuations, for example due to the sudden connection of spaces with a different pressure level, actuation of cutoff and control fittings with short opening and closing times, and especially due to nonuniformities in the operation of positive-displacement pumps, in which pump pulsations arise, and also due to processes of turning positive-displacement pumps on and off.

Damper arrangements of varied designed are used to attenuate pressure fluctuations, periodic pressure oscillations or the resulting acoustic oscillations. Thus, hydraulic dampers can be based on the principle of hydropneumatic bladder-type and diaphragm accumulators or can be made as reflection dampers (silencers).

The general prerequisite for the effectiveness of hydraulic dampers is that the damper housing encompasses a relatively large volume; this in turn leads to correspondingly large dimensions of the damper housing. In hydraulic systems in installations in which only a limited installation space is available in the machinery room which contains the hydraulic pump, to the output of which a hydraulic damper must be connected which attenuates the pressure oscillations and acoustic oscillations of the pump pulsation, problems frequently arise due to the space requirement of the hydraulic damper which is to be accommodated with a relatively high-volume

damper housing. This problem arises to an increased degree in conjunction with hydraulic systems of injection molding systems, where good damper action at the output of the pertinent hydraulic pump can be required, but generally only a very limited installation space is available for the high-volume damper housing.

The object of the invention is to provide a hydraulic damper with a construction which enables connection to the pertinent hydraulic system even with limited installation space and at a relatively large volume of the damper housing.

As claimed in the invention, this object is attained by a hydraulic damper as specified in claim 1 having

- a damper housing with a leading dimension which defines the longitudinal axis of the housing;
- a connecting block for fluidic connection of the damper housing to the pertinent system and
- a linking means which is assigned to the connecting block for mounting of the connecting block and thus of the damper housing on the system in selectable rotary positions, relative to the connecting axis which runs transversely to the longitudinal axis of the housing.

In that, as specified in the invention, the damper housing may be connected to the pertinent hydraulic system in the desired rotary position, the damper housing can be housed in the pertinent installation space in an orientation such that the leading dimension of the damper housing extends in the direction which optimally uses the space. As a result, damper housings in an elongated construction mode and with a comparatively large volume can be accommodated in

constricted machinery spaces. The possibility afforded by the invention for selecting the rotary position of the damper housing around the connecting axis which runs transversely to its longitudinal axis also enables direct connection, for example at the output of the pertinent hydraulic pump. Even under constricted installation conditions for example hydraulic dampers of the reflection type, in which a comparatively large volume of the damper housing is necessary, can be directly connected to the pertinent hydraulic pump with the limited available installation space.

By preference the connecting axis to the leading dimension of the damper housing which defines the longitudinal axis of the housing runs at least approximately vertically.

In one advantageous embodiment the linking means has a pump connecting piece which forms the fluidic connection between the connecting block and a hydraulic pump and which can be fixed at the output of the hydraulic pump in selectable rotary positions relative to the connecting axis.

If the output of the pump is provided for connection of linking parts according to the SAE standard, i.e., has a corresponding hole pattern for mounting screws, provision may be made of the annular body as the pump connecting piece of the linking means attached to the output of the pump with a ring of holes which is located along the periphery of said annular body. Of these holes, those which correspond to the desired rotary positions of the connecting block relative to the connecting axis can be selected for the engagement of mounting screws which are provided on the connecting block. In these embodiments a connection of the hydraulic damper to the output of the pump is possible in rotary steps which correspond to the spacing of the holes of the ring of holes in the pump connecting piece.

If on the other hand the pump connecting piece has a round end flange which in the selected rotary position can be fixed relative to the connecting axis by means of half ring-like

SAE flange clamping jaws which can be screwed to the SAE connecting parts of the output of the pump, continuous selection of rotary positions is possible.

Reference will now be made to the accompanying drawings using the embodiments shown in the drawings, and in which:

- FIG. 1 presents a diagram illustrating a side view of one embodiment of the hydraulic damper as claimed in the invention,
- FIG. 2 presents a horizontal section of the embodiment from FIG. 1 drawn on a larger scale compared to FIG. 1, and
- FIG. 3 presents a perspective oblique view of the end area of a second embodiment of the hydraulic damper which is connected to the output of the hydraulic pump by way of an SAE connection, which view is drawn on a larger scale and also dismantled and exploded.

FIGS. 1 and 2 show a first embodiment of the invention, namely a reflection damper (silencer) having an elongated damper housing 1 with a leading dimension which defines the longitudinal axis 3 of the housing. The damper housing 1 is fluidically connected on its one end which is located on the right in the figures to the connecting block 5 which in turn is connected by way of the pump connecting piece 7 to the output of a hydraulic pump which is not shown.

In the capacity as a hydraulic damper of the reflection type, i.e., as a resonator with an interference action, the accumulator housing 1 contains a damping pipe 9 which extends coaxially to the longitudinal axis 3 between the entry end 11 and the exit end 13 of the damper housing 1. The damping pipe 9 in the area of its half length has slot openings 15 for coupling of the fluid oscillations in the damping pipe 9 to the fluid volume 17 surrounding it within the damper housing 1. The holes 19 constitute permanent ventilation of the space containing the

volume 17 so that the hydraulic dampers need not be pre-charged for starting, because air accumulations are discharged by way of the holes 19.

On the entry end 11 and on the exit end 13 the damper housing has one inside thread 21 respectively, into which screwed pieces 23 are screwed; in the inner hole of the screwed pieces which is concentric to the longitudinal axis 3 the ends of the damping pipe 9 are held. The O-rings 25 which sit in the inner hole of the screwed pieces 23 elastically support the damping pipe 9 so that the pipe 9 does not produce any rattling noise in operation, without narrow tolerances being necessary.

On the entry end 11 and on the exit end 13 there is one outside thread 27 respectively on the damper housing 1. A connecting flange 29 is screwed onto the outside thread 27 on the exit end 13 in order to produce the connecting link to a consumer, for example by means of an SAE connecting means on a pressure hose or the like. With the outside thread 27 on the entry end 11 the damper housing 1 is screwed to the connecting block 5, a threaded seal 31 being provided on the outside thread 27. The connecting block 5 with its inner chamber 33 which is fluidically connected to the damper housing 1 forms a preliminary chamber for the resonator system which is located in the damper housing 1. With its bottom-side opening 35 the chamber 33 of the connecting block 5 is fluidically connected through the pump connection 7 to the output of the hydraulic pump which is not shown.

As is apparent from FIG. 2, the connecting block 5 has four holes 37 for engagement of mounting screws which are not shown and with which the connecting block 5 can be screwed to the pump connecting piece 7. The pump connecting piece 7 which is designed as an annular body in the embodiment from FIG. 1 and 2 and which for its part can be linked to the output of the hydraulic pump, for purposes of interaction with the holes 37 on the connecting block has a ring of holes 39 which are located on the same radius as the holes 37 of the connecting block 5 concentrically to a connecting axis 41 which runs perpendicular to the longitudinal axis 3 of the

housing and which is defined by the center of the opening 35 which links the chamber 33 to the hydraulic pump. Thus the connecting block 5 can be turned around the connecting axis 41 in order to produce alignment between the desired holes 39 of the ring of holes on the pump connecting piece 7 with the holes 37 on the connecting block 5, so that the damper housing 1 can be aligned with its longitudinal axis 3 to the desired rotary positions, relative to the connecting axis 41. When the damper housing 1 is mounted on the pertinent hydraulic pump, the longitudinal extension of the damper housing 1 may be turned into a position in which the utilization of space is optimal under the respective installation conditions. In other words, this means that even under difficult installation conditions, a damper housing 1 with a comparatively large volume can be accommodated.

While in the embodiments shown in FIGS. 1 and 2 the rotary position of the damper housing 1 can be set in rotary steps which correspond to the spacing of the holes 39 on the periphery of the pump connecting piece 7 which is made as an annular body, the embodiment from FIG. 3 enables continuous setting of the rotary position of the damper housing 1 around the connecting axis 41. For this purpose, in the second embodiment the pump connecting piece 7 is not made as an annular body with a peripheral ring of holes, but in the form of a circular cylindrical hollow body used as a fluid feed pipe which produces the inner chamber 3 of the connecting block 5 with the output of the hydraulic pump, which output is designated 43 and which is suggested schematically in FIG. 3. The hollow body of the pump connecting piece 7 which is concentric to the connecting axis 41 for the fluidic connection to the inner chamber 33 of the connecting block 5 has a wall penetration 45 which is flush with the longitudinal axis 3 of the damper housing 1.

On the open end which projects from the connecting block 5 and which can be attached to the pump output 43 for fluid entry, the pump connecting piece 7 has an end flange 47. By means of the half ring-shaped flange clamping jaws 49, as are common for connecting links according to the SAE standard (J 518), the pump connecting piece 7 can be fixed on the pump

output 43. By turning the round end flange 47 of the pump connecting piece 7 within the clamping jaws 49 which annularly surround the end flange 47, the rotary position around the connecting axis 41 can be selected continuously as desired.

It goes without saying that instead of the damper housing 1 of a reflection damper which is shown for the two embodiments, damper systems with a different mode of operation could be equally mounted on the connecting block 5, for example hydraulic dampers which are based on the principle of hydropneumatic bladder-type and diaphragm accumulators.

The hydraulic damper as claimed in the invention can be delivered in the manner of original equipment for a specific type of a plastic injection molding machine. Depending on space conditions on the respective machine, preferred holes on the pump connecting piece are provided over the existing hole pattern, and with subsequent deliveries a complex hole pattern on the pump connecting piece can then be dispensed with. In fact it is then possible to select a certain hole pattern in which the pertinent hydraulic damper assumes the desired position for the machine type provided for it on a plastic injection molding machine.